FORUM

ECONOMIES OF SIZE IN WHEAT PRODUCTION: COMMENT

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In a recent paper in this *Review*, Longworth and McLeland [1] derived a series of statistical cost functions for wheat production in the Boolooroo Shire of New South Wales. Cross-sectional data for the years 1966 and 1967 were used in the analysis and the power function was chosen as the preferred equation to describe the cost-size relationships.

One disquieting feature of the analysis to this writer was the apparent extent of heteroskedasticity among the residuals of the fitted functions, as illustrated by study of figures 1 and 2 on page 58 of the paper. The residual variance would appear to be much larger at the relatively small enterprise sizes than at larger ones. It would have seemed appropriate therefore to have given observations in the lower size categories proportionately less weight in the regressions. This would have generated more statistically efficient estimates of the parameters, although the Longworth-McLeland estimates using ordinary least squares regression and independently weighted estimators using generalized least squares would both be unbiased.[1] The expected result of giving less weight to small enterprises in the regression analyses would likely be to shift the curves. A move to the left would make their L-shape more pronounced. However, the precise direction of movement and change in the shape of the curves is difficult to predict.

The above matter also relates to the important question of the proper interpretation to be given to fitted cost functions. Presumably, the larger variability found in average costs on the smaller wheat enterprises implies these are subject to more variability in managerial and other efficiencies than their larger counterparts. Longworth and McLeland indicated [1, p. 61] that there was no tendency for size and the adoption of new methods or yields to be positively correlated. Hence there must

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[1] Using the data instead of prior knowledge to derive the weights does, however, generate statistical bias. In the absence of *a priori* knowledge of the variance—covariance matrix, reliance is generally placed on the observed data residuals to correct for heteroskedasticity. As Longworth and McLeland tried several functional forms before selecting the power function, there are already sizeable statistical biases in their estimates. Added bias from use of observed residuals to correct for heteroskedasticity would appear acceptable under these circumstances.

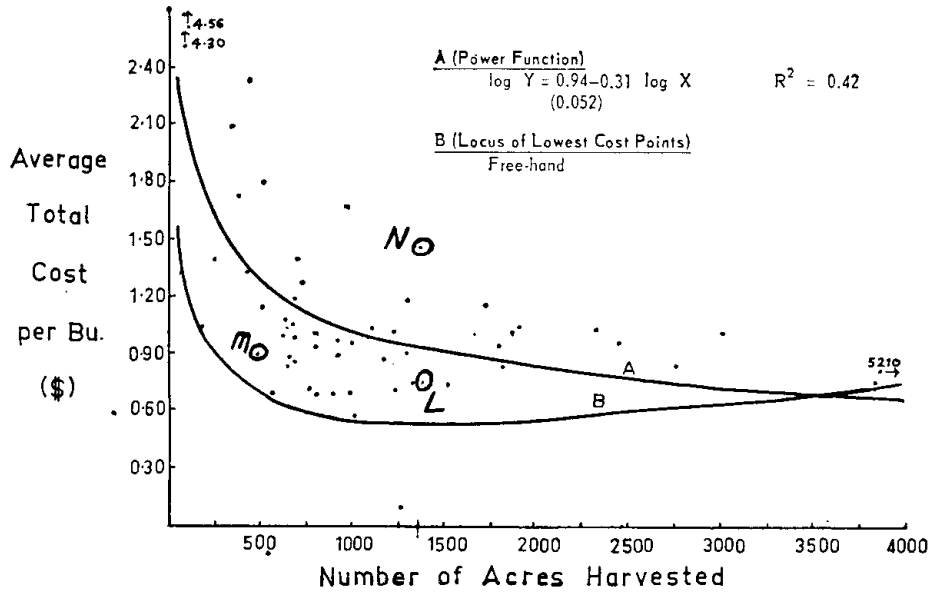

FIGURE 1: *Scatter Diagram and Various Cost Models with Output Measured by Number of Acres Harvested* (1966)
Reproduced from Longworth and McLeland [1, p. 58]

be other factors which explain this variability. In view of this, it may be incorrect to conclude [1, pp. 63–64]: "... the estimated cost functions provide a useful planning guide to the cost/size relationship in both good and poor seasons".

It is doubtful if these cross-sectional cost curves should be interpreted as implying that small enterprises can grow to become larger and in the process reduce average costs per bushel. An L-shaped cost curve may just mean that the efficient enterprises grow big rather than that large enterprises *always* realize cost economies. It may not mean that small enterprises in the industry can grow to become the low-cost units. Preston and Keachie [2] for example suggest that some of the evidence that has been taken to reflect economies may in fact reflect the accumulation of experience by long-established large enterprises. Large firms may have low unit costs because of experience, not their present size. This discussion can be illustrated by reference to figure 2 in Longworth and McLeland [1, p. 58], which is reproduced again here with a few additional labels. A farmer growing about 500 acres of wheat with an average cost represented by the point *M* may find that his particular planning curve takes him to point *N* when he grows about 1,400 acres rather than a point like *L*. There can be no guarantee that growing a larger area of wheat, *ceteris paribus*, will entail movement down a smooth, *L*-shaped curve such as that depicted in the figure. Longworth and McLeland [1, p. 57] in fact pointed out that there was a discontinuity in average costs at around 1,000 acres. This coincided

with the maximum technical capacity of one large set of cultivating and harvesting equipment. This is only one of the reasons why these cost curves must be used with extreme caution as "planning guides". Examination of cost changes that actually result from size movements over extended periods may reveal different cost curves to those in cross-sectional analyses.[2]

One specific point requires mention in connection with the allocation of overhead costs, particularly machinery. On smaller farms, owners and sharefarmers generally carry out a lot of contract work off the farm. Longworth and McLeland's method of allocating overhead costs does reduce these costs in proportion to the amount of contract and other income relative to wheat. However, a greater reduction is called for with machinery depreciation when the non-wheat income is from contracting as opposed to income from other crops and livestock. This adjustment would likely further reduce the significance of any size economies.

REFERENCES

[1] LONGWORTH, J. W. and MCLELAND, J. L., "Economics of Size in Wheat Production", this *Review*, Vol. 40, No. 2 (June, 1972), pp. 53–66.

[2] PRESTON, L. E. and KEACHIE, E. C., "Cost Functions and Progress Functions: An Integration", *American Economic Review*, Vol. 56, (March, 1964), pp. 100–107.

[3] STIGLER, G. J., "The Economies of Scale", *Journal of Law and Economics*, Vol. 1, No. 1 (1958), pp. 54–71.

[2] Stigler's [3] "survivorship" technique is an example of a dynamic model of the size of firm. Its fundamental postulate is that the competition of different sizes of firms sifts out the more efficient enterprises. The main limitation of this technique is that it involves *ex post* changes in firm size distributions. These may or may not be good *ex ante* predictions of actual or desirable size movements.